# ENVIRONMENTAL STUDIES ALONG MANGALORE COAST BASED ON REMOTE SENSING AND GIS TECHNIQUES

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By

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# ENVIRONMENTAL STUDIES ALONG MANGLORE COAST BASED ON REMOTE SENSING AND GIS TECHNIQUES

The coasts, the dynamic function of oceans, atmosphere and land, undergo changes in shape and position due to natural forces and anthropogenic activities. The anthropogenic activities cause changes in coastal environment at a faster rate. Approximately 50% of the world's population lives within a 150 kilometer of coastline and it is compressed in to an area that consists of only 8% of the world's terrestrial surface that is habitable. Coastal environment serve a wide variety of functions including fishing, recreation, commerce, navigation and are characterized by a variety of factors like wave energy, tidal range, sediment supply, sediment type and tectonic movement. The coastal zones are under threat and are subjected to significant changes due to developmental activities, industrial growth and urbanization. Over exploitation of natural resources, shipping and transportation, waste disposal and improper land use practices are some of the human activities degrading the coastal environment. The effects are further exacerbating with the input of pollutant wastes. Environmental deterioration is the result of miss management of the natural resources. It reflects the maladjustment between the man and environment. For the effective planning and management of the coastal environment, there is a need for extracting the information regarding the existing land use/cover, siltation and also on various kinds of pollution. In this regard implementation of the Integrated Coastal Zone Management (ICZM) concept is needed. It is multidisciplinary and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning, decision making, management and monitoring of implementation. ICZM seeks, over the long-term, to balance environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics.

Countries which have coastline all around the globe have been witness to the coastal erosion phenomenon; any attempt to handle such coastal related problems requires a thorough understanding of the factors and processes involved in the coastal geomorphological system. Nearshore hydrodynamics and sediment transport are the important factors that influence the coastal morphological changes. Processes such as tides and waves, river discharge, wind stress and turbidity currents modulate the transport and distribution of suspended sediments in coastal

environment. Study on sediment transport aspect deals to solve many environmental, geotechnical and geological problems.

Water is one of the most essential materials in our day-to-day life is becoming scarce in rural as well as urban areas mainly due to population growth, reduction in infiltration rate as a result of deforestation in rural areas and large scale paving of the surface in urban areas. The topography and other factors limit the storage of water. Where the surface water is scarce, the alternative source of groundwater assumes importance in the context of water supply. In this regard delineation of potential ground water zone is very essential. Water scarcity and water pollution go hand in hand. Water quality degradation is a consequence of human activities, and land use practices and economic development. Land use practices affect the quality of waters in streams, lakes, groundwater and ultimately the marine environment. Water quality monitoring is inadequate in several parts of the world. In some countries it is not yet developed, in others it is declining. Monitoring the water quality of any water resource system in respect to its pollutants is a pre-requisite for all environmental development and planning. The extent of pollution in our fluvial systems is quite alarming due to indiscriminate misuse through anthropogenic activities with pollutants contaminating the vital components of our environment. Environmental parameters in various, intimately interrelated, matrices are very sensitive in an open system, where a change in one matrix would mean a change in all others.

Some of the problems reported in and around the Mangalore environs are

- The dispersal of untreated industrial and domestic wastes is causing degradation of water quality.
- Intensified coastal land uses and anthropogenic activities have increased the quantity of pollutants in the near shore waters and in the estuary.
- Siltation in the navigational channels of the estuaries causes navigational problems.
- Sand mining from the estuaries and beaches has resulted in coastal erosion and beach retreat and damage to coastal infrastructures.

In the proposed study an attempt has been made to study the coastal environs of Mangalore through remote sensing and GIS techniques. Due to its synoptic view and repetitive coverage, the satellite images are used extensively to monitor the coastal environment. The satellite data are analysed using visual and digital analysis techniques. The study focuses on various environmental issues and

generated a detailed database on the following themes.

- Groundwater prospects evaluation
- Land degradation and its causes
- Physico-chemical characteristics of the surface water
- Near shore processes
- Coastal zone management

**Study area**

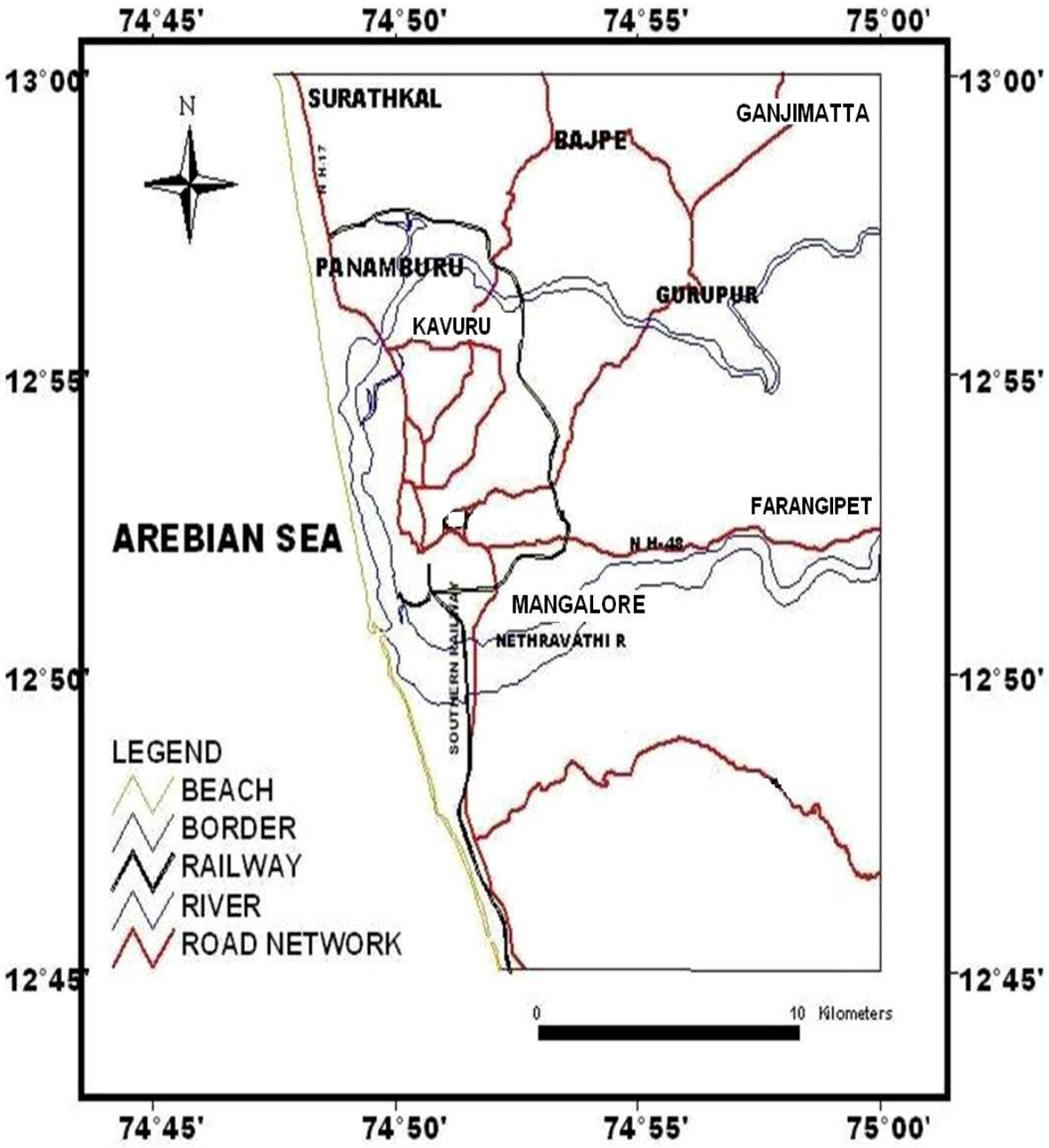
Mangalore is an important port city in south India and located at the confluence of Nethravati and Gurupur rivers. The city is an administrative, commercial, educational, and industrial center. It is bound in the east by the Midlands and the Western Ghats and in the west by the Arabian Sea**.** . The study area extends from Thalapady (12° 45' and 13° 00’ N) in the south to Surathkal (74° 45' and 75° 00' E) in the north. The area is characterized by a tropical monsoon climate and receives an annual average rainfall of more than 3.5 m. The ambient temperature varies minimum from 17ºc to a maximum 37ºc.Most of the geomorphic units in the study area are covered residential and plantation entities.

The major industries located in and around Mangalore are: Mangalore Chemicals and Fertilizers Ltd. (MCF), Kudremukh Iron Ore Company Ltd. (KIOCL), Mangalore Refinery and Petrochemicals Ltd. (MRPL), BASF and ELF Gas.

**The main objectives of the present study are**

1. to assess, map and monitoring the coastal environment,
2. to generate maps highlighting the spatial distribution of land use/cover, suspended sediments and ground water potential zone.
3. to contribute to setting up optimum rules for the development and management of coastal environment, and
4. to achieve and maintain desired functional and/or quality levels of coastal systems, as well as to reduce the costs associated with coastal hazards to acceptable levels.

To achieve these objectives, in the proposed study an attempt has been made to study the Mangalore and its environs through an integrated approach using remote sensing, GPS and GIS techniques.




Map of the study area

The thesis has been organized under 8 chapters, they are as follows

## Chapter 1

The first chapter starts with a general introduction, followed by different subsections such as 1) Specific introduction of the study area 2) The main objectives of the study 3) Details pertaining to climatic parameters such as temperature, humidity, rainfall. 4) Coastal hydrodynamic characteristics like waves, currents and tides 5) Bathymetry. Detailed review of literature in relevant fields of the present study such as groundwater prospects evaluation, land use/cover, physico-chemical characteristic of surface water, coastal process, shoreline change analysis and coastal zone management

Chapter 2

This chapter includes the materials, softwares and methodologies adopted for the preparation of various thematic maps related to the groundwater prospects evaluation, land use/cover, suspended sediment, shoreline change studies and methodology adopted for understanding the physico-chemical parameters of surface waters and also provides a brief description on Remote sensing, Geographic information system and Global positioning system**.**

## Chapter 3

This chapter mainly focuses on the hydrological aspects and groundwater prospects. The groundwater potential zone mapping in a GIS environment has been carried out by integrating the thematic maps like geology, lineament, geomorphology, DEM, drainage frequency and land use/cover. After understanding their behavior with respect to groundwater, the different classes were given with suitable weights. All the thematic maps were converted into grids with related item weight and integrated with one another through GIS (Arc/Info grid environment). As per the analysis, the total weights of the final integrated grids were derived as sum of the weights assigned to the different layers based on suitability. The delineation of groundwater prospect zones was made by grouping the grids of the integrated layers into different prospect zones. The upper limit of the weight was derived as excellent followed by very good, good, moderate and poor. Most of the study area falls under the moderate zone, remaining parts of the study area comes under excellent very good, good and poor.

## Chapter 4

This chapter deals with land use/cover change analysis of the study area. Land use/cover maps have been generated using multitemporal data like topographical map of 1967 Landsat MSS of 1973; IRS-1D LISS-III of 2000 and 2006. Based on the interpretation of the multidated data analyses, the changes took over for a period of 39 years was provided. Standard NRSA/USGS classification system has been adopted for classifying the images. In the case of 2000 and 2006 images, 22 useful classes have been demarcated whereas for 1972 image it was restricted to 15 classes. In the image classification stage, hybrid classification technique has been applied and more than 85% of accuracy has been achieved. The results obtained indicate that change in the land use/cover pattern has been very dynamic for the past two decades. Over a period of 35 years, the growth rate of settlement area is high. The main factors affecting the urban fringe land transformation are growth of industries, commercial and institutional developments. The reduction in the agriculture land indicates that there is an increase in the land conversion rate. The study also reveals that increase in open scrub and decrease in open forest shows the extent of deforestation. Increase of waterlogged area between 2000 and 2006 is alarming. Overall, the study highlights the degree of change in various land use category, their consequences and measures for the sustainable development.

## Chapter 5

This chapter deals with the Physico-chemical characteristics of surface water. Water samples have been collected at 28 prefixed locations, which include sea shore, estuary and rive water bodies. Physical parameters like pH, salinity and electrical conductivity were measured with YSI 33 model portable conductivity meter. Heavy metals such as Iron, Copper, Chromium, Lead and Zinc have been determined through Atomic Absorption Spectrometer.

In the present study descriptive statistical analysis like maximum, minimum, mean and standard deviation, and Pearson pair wise correlation matrix were applied for detailed study.

The mean concentration of the heavy metals in all the water body shows a decreased value in the order, Fe>Pb>Cr>Ni>Cu. The data reveals that the values of metals in the water show no considerable variations in the samples with respect to their chemical characteristics.

## Chapter 6

In this chapter the sediment dynamics in the nearshore region is discussed.

To trace the sediment transport pattern and their concentration along and across the nearshore in space and time, IRS P4 OCM data has been utilized, quantitative estimation of the suspended sediments has been carried out using the modified Tasan (1994) algorithm developed by NRSC Hyderabad. For validation of the OCM derived TSS, in-situ data of transects have been collected. During monsoon season due to high energy waves and strong monsoonal currents, erosion is observed in the foreshore and the transport of sediment is seaward. During post monsoon, the sediments move landward leading to foreshore accretion, so there is a spatial and temporal variation in erosion and accretion pattern and redistribution of materials in the surfzone. Net accretion and erosion have been quantified for a period of 40 years by generating maps based on multidated satellite data and topographical maps. The impact of various coastal structures like sea walls, breakwaters, groins and other manmade structures on the coastal zone are also discussed

## Chapter 7

A brief introduction about the coastal zone management, main issues of the coastal zone such as pollution, urbanization, coastal land reclamation, coastal erosion/accretion, Resource depletion and Mangroves degradation are discussed in detail in this chapter. Need for coastal zone management, coastal zone management in global scenario, national and state level, Policy implementation, Integrated coastal zone management are also discussed here in detail. Discussion also comprises of impacts, remedies and recommendation about various coastal zone problems.

## Chapter 8

This chapter is devoted to summary and conclusion

Signature of the Research Supervisor

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Signature of the Research student

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